Appendix C

ENGINEERING CONSIDERATIONS

C-1: O&MRR&R Cost and Narrative Description

C-2: H&H Analysis

Appendix C-1

O&MRR&R Cost

Immediate Repairs and Rehabilitations:

Repair Item	Priority	Estimated Cost
Spillway Piers/Dam	1	$ 3,375,000
Filling/Emptying Valves/Lock	2	$ 200,000
Wall Erosion Repair/Lock	3	$ 280,000
Hydraulic Repairs/Lock	4	$ 276,000
General Erosion Repair/Lock	5	$ 150,000
Control Building Roof/L & D	6	$ 8,000
Major Rehab Study/L & D	7	$ 250,000
Gate Hoists, Chains, Etc./Dam	8	$ 2,050,000
Timber Sidewall/Lock	9	$ 25,000
Misc./Lock & Dam	10	$ 200,000
Total		**$ 6,814,000**

Annual Operating Costs/Dam & Gates (COE ownership and operation):

Item	Estimated Cost
COE Labor (inspections & operation)	$ 95,500
Parts & Materials	$ 30,000
Minor Contract Repairs	$ 80,000
Total Annual Costs	**$215,500**

Future Repairs and Rehabilitations (Years 11 to 30):

Item	Cost/Years 11 thru 19	Cost/Years 20 thru 30
Rehab Electronic Equipment	$ 225,000	$ 256,000
Rehab Hydraulic Equipment		$ 125,000
Mechanical Rehab/Gates	$ 35,000	$ 150,000
Rehab Electrical Equipment		$ 90,000
De-watering and Inspection/Lock		$ 650,000
Painting/Exterior	$ 60,000	$ 80,000
Erosion Repairs		$ 125,000
Rehab Lock Filling/Emptying Valves		$ 200,000
Structural Repairs		$ 550,000
	$ 320,000	**$2,226,000**

Description of Work for Immediate O&MRR&R

Work Item - Description of Work

Dam Spillway Piers (Priority 1) - The spillway piers of the dam have extensive cracking which should be repaired or the piers completely refurbished as soon as possible. The depth of the soft cement paste in the concrete should be investigated. It may be possible to only remove and replace the outer shell of concrete on each pier. Previous proposed repairs to clad the piers with steel plate may not be needed. Replacing the outer shell of the pier with reinforced concrete may be an alternative. To see if this is feasible, concrete drill holes in the area of the cracks would be required to determine the depth and quality of the concrete. The vertical concrete drill core taken in 1986 in Pier No. 2 found poorly consolidated concrete in parts of the pier. Three or four horizontal drill cores 2 to 3 feet deep are needed to better determine a feasible method of repair. Since there is little or no displacement of the piers, the condition of the surface concrete suggests that it is possible the depth of cracks is limited to a few inches. A high water-cement ratio would produce shrinkage cracks on the surface. With soft cement, the surface concrete could have eroded easily. It is also possible that the concrete contains reactive aggregate. Further investigation of the concrete is required to determine the appropriate course of action.
Estimated cost of repairs equals $3,375,000.

Lock Filling/Emptying Valves (Priority 2) – The valves are in poor condition and lock operational restrictions have been imposed to prevent failure of the valves, and thus the lock operational capabilities. The landside wall filling valve is working erratically and sticks during operation. The valve bearings are in very poor condition (worn out). The failure of the valves is imminent and need to be rebuilt as soon as possible. When the valve bearings fail, the lock will be inoperable. Estimated cost of repairs equals $200,000.

Lock Wall Erosion Repair (Priority 3) – During de-watering in 1998 and further confirmed by a dive inspection in May 1999, it was revealed that approximately 50 feet of a rock crib is missing from the downstream end of the lock riverside wall, and that there is a depression in the river bottom approximately 13 feet deep at the end of the wall. Also, a dye test was performed in the lock chamber in the area of boils observed in the lock floor during the de-watering. Several areas of seepage were noted along the riverside wall. The loss of foundation material under the wall has an adverse effect on the lateral stability. Instrumentation indicates the riverside wall moves up to a ¼-inch at the base when the lock is filled if the differential heads between the upper and lower pools exceed 16 feet. Estimated cost of repairs equals $280,000.

Lock Hydraulic Repairs (Priority 4) – Due to hydraulic pipe leaks and the age of the hydraulic pump, reservoir, etc., the hydraulic system for the lock needs to repaired or replaced with new piping and operating equipment. Problems existed during the refilling of the lock after de-watering due to contamination in the hydraulic system. Estimated cost of repairs equals $276,000.

Lock General Erosion (Priority 5) – Several areas of excessive erosion have been observed in the channel bottom and side slopes immediately adjacent to the upstream face of the dam and the downstream edge of the stilling basin. Hydrographic surveys have been performed to locate areas and extent of erosion. These areas need to be filled so as not to cause damage to the lock and dam. Estimated cost of repairs equals $150,000.

Control Building Roof (Priority 6) – The roof of the control building for the lock and dam requires replacing. It has been years since the roof has been replaced. Estimated cost of replacement equals $8,000.

Major Rehab Study (Priority 7) - A major rehab study is required to further investigate and identify the overall repairs and replacements needed to keep the lock and dam structurally sound and operating as intended. Due to the age of the structure (1937) and the lack of funds to maintain the facility in recent years, much of the operating equipment not previously noted for repair or replacement needs to be investigated. This study would accomplish the effort to identify and prepare scopes of work for the necessary repairs required over the next 30 years. Estimated cost of study equals $250,000.

Dam Gate Hoists, Chains, etc. (Priority 8) - In 1996, new hydraulic hoists and improvements to the remote control system were performed for the dam spillway gate nos. 2 and 3. Similar work to replace the gate hoists, chains, brake drums, pads, wheels, etc. are required for gate nos. 1, 4, and 5. The brake drums and pads, hoists, and chains are very worn. Estimated cost of repairs equals $2,050,000.

Lock Timber Sidewall (Priority 9) – The lock timber sidewalls are in poor condition and are in need of replacement. Estimated cost of replacement equals $25,000.

Lock and Dam Miscellaneous Repairs and Replacements (Priority 10) – Miscellaneous repairs and replacements are required at the lock dam. Additional lightning protection for power, communications, and personnel should be provided. The control building has experienced numerous lightning strikes and caused damage to the power and communication lines. A solution to minimize problems with lightning would be to install the communication and power cables under the lock in lieu of over the lock. Other items include installing heaters and thermostats for humidity control at the local control panel to prevent rusting inside the panel; install covers for each of the two new hydraulic control panels to prevent rain from entering the electronic controls when the panels are open; install braces or a strong arm for the hinged covers for the hydraulic cylinders; install ventilation for the gate hoists; install an alarm to notify operator of any malfunction in the operation of spillway gates; install a vibration sensor so as to cut off power to the spillway gate hoists in the event of severe gate vibration which will damage equipment and stress the dam piers; install a battery backup system for the controls; install a trash boom upstream of the spillway and bar screens attached to the downstream truss members of the spillway gates (large trees that have stuck in the gate truss have bent several members). General housekeeping of the lock and dam is required for the dam including the hydraulic system needs to be checked and leaks repaired,

control switches need to be checked and repaired as needed, etc. Estimated cost of repairs equals $200,000.

Description of Work for Future O&MRR&R
(Years 11 to 30)

Work Item - Description of Work

Rehab Electronic Equipment – Electronic equipment including controls, wiring, etc. for the remote operation of the dam spillway gates will require repairs and replacements over the next 10 to 30 years to maintain the operational capability of the gates from J. Strom Thurmond Dam. Estimated costs equal $225,000 for years 11 thru 19; $256,000 for years 20 thru 30.

Rehab Hydraulic Equipment – Hydraulic systems for the lock and dam including pumps, valves, piping, etc. will require repairs and replacements over the next 11 to 30 years to maintain the operational capability of the lock and dam. Estimated costs equals $125,000 for years 20 thru 30.

Mechanical Rehab of Gates – The dam spillway gates and the lock miter gates will require periodic repairs and replacements of parts required for the gates to operate safely over the next 10 to 30 years. Similar repairs that will be required in the years 20 to 30 have been identified above for required spillway gate repairs (Priority 8) and as performed during the repairs to the lock miter gates in 1998. Estimated costs equals $35,000 for years 11 thru 19; $150,000 for years 20 thru 30.

Rehab of Electrical Equipment – Electrical equipment such as motors, controls, wiring, etc. will require repairs and replacements as general operational maintenance over the next 20 to 30 years. Estimated costs equals $90,000 for years 20 thru 30.

De-watering and Inspection of Lock – De-watering, inspections, and repairs to the lock similar to that performed in 1998 will be required in years 20 and 30 (every 10 years). Estimated costs equals $650,000 for year 20 and year 30.

Painting (Exterior) of Lock and Dam – General painting of lock and dam equipment, piping, handrails, steel superstructure, catwalks, etc. for rust and corrosion protection from environment. Estimated costs equals $60,000 for years 11 thru 19; $80,000 for years 20 thru 30.

Erosion Repairs – Periodic filling of eroded areas to prevent undermining of lock and dam similar to the required repairs identified above (Priority 5). Estimated costs equals $125,000 for years 20 thru 30.

Rehab Lock Filling/Emptying Valves – It is anticipated that similar repairs to the required repairs noted above for Priority 2 will be needed one time in the next 20 to 30 years. Estimated cost of repairs equals $200,000 for year 20 or 30.

Structural Repairs – It is anticipated that repairs to cracks will be required to the lock and dam concrete structure (dam piers and lock walls) in the next 20 to 30 years. Estimated cost of repairs equals $550,000 for years 20 thru 30.

Note: The above cost estimates for the required and anticipated repairs for the New Savannah Bluff Lock and Dam are very preliminary. Some estimates are based on repair work that has been performed to date. Since the Corps of Engineers has the requirement by the State Historic Preservation Office (SHPO) to replace parts and equipment with similar kind, the estimates have included costs for new equipment and parts.

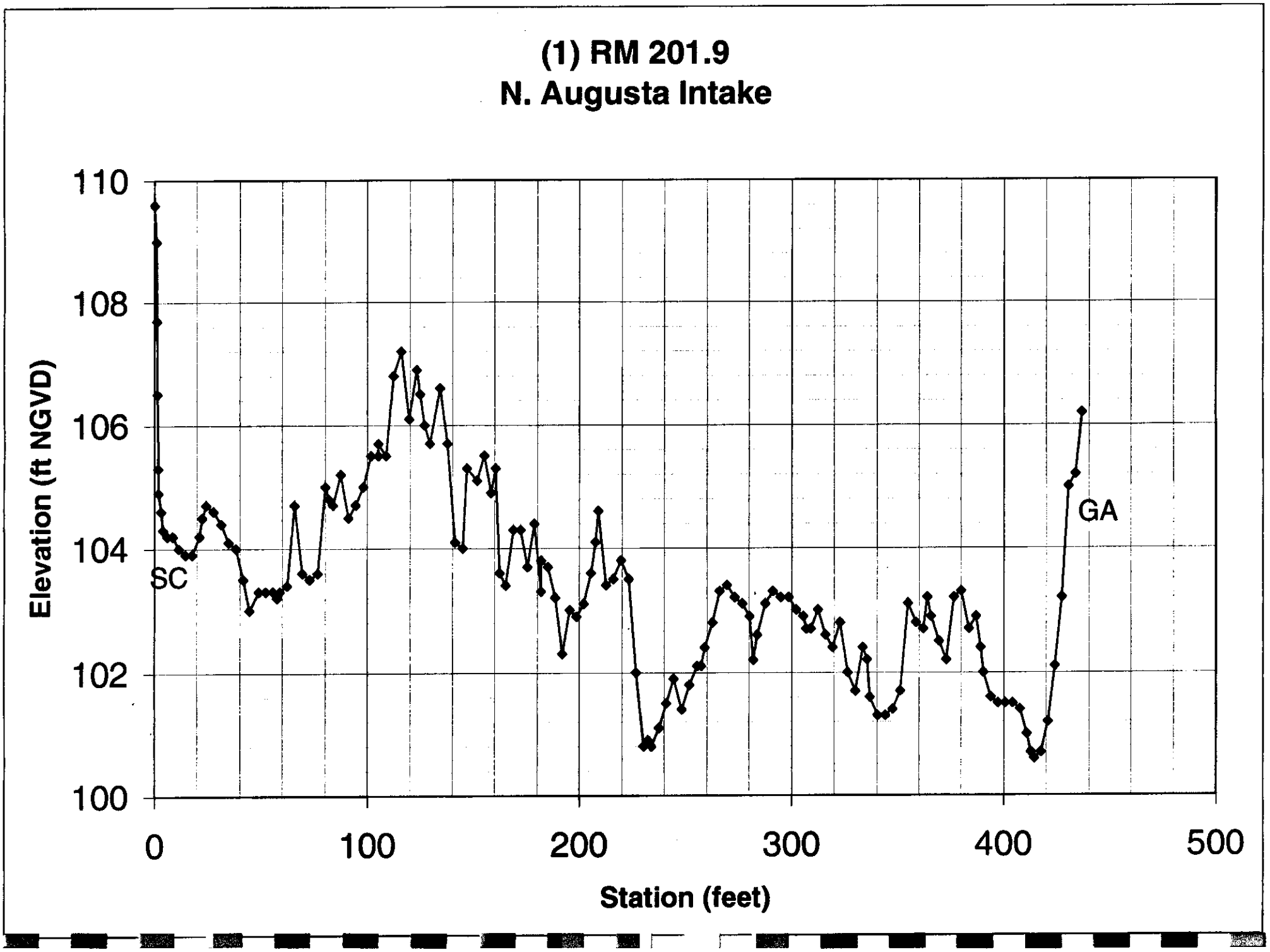
Appendix C-2

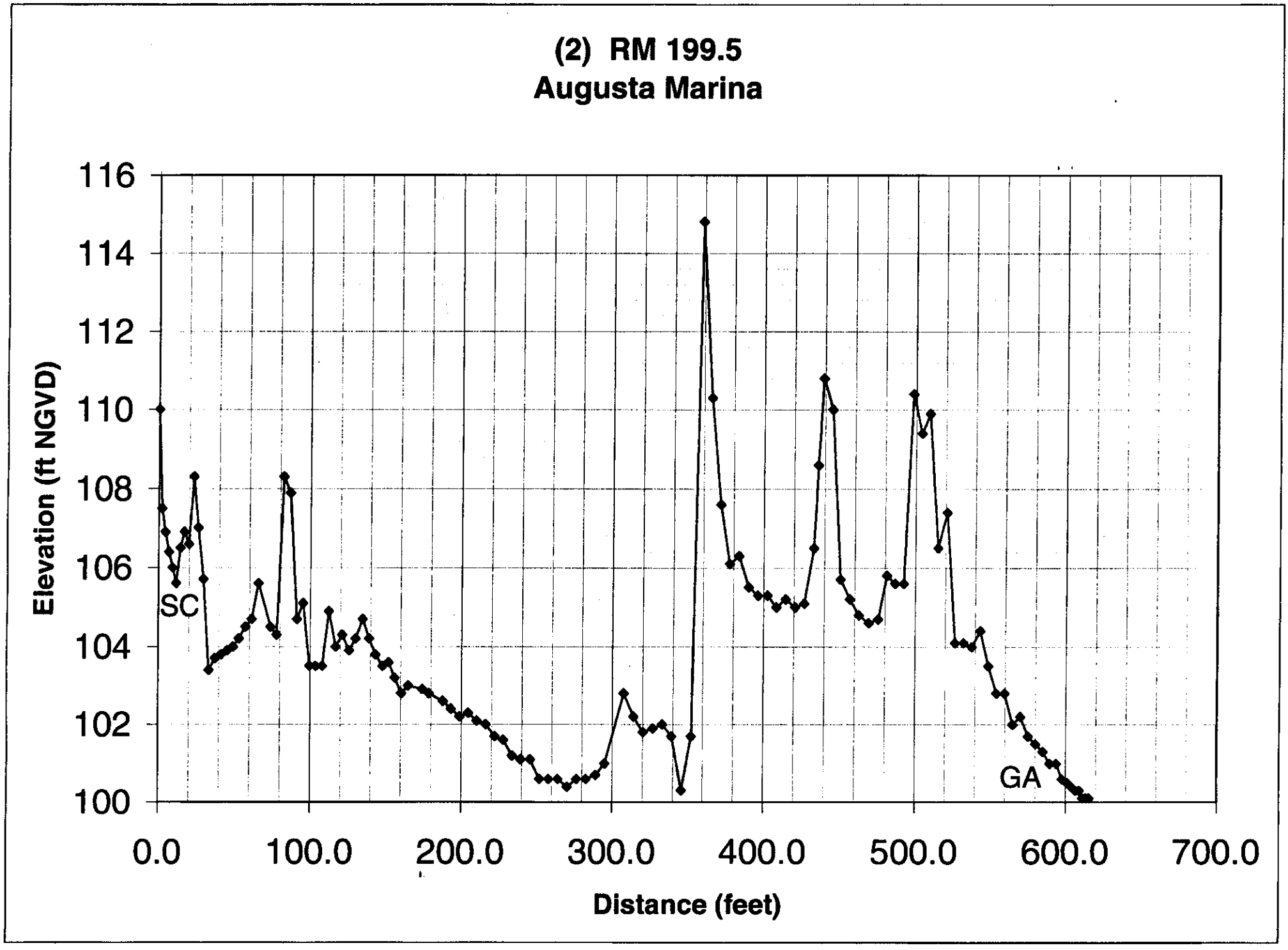
H&H Analysis

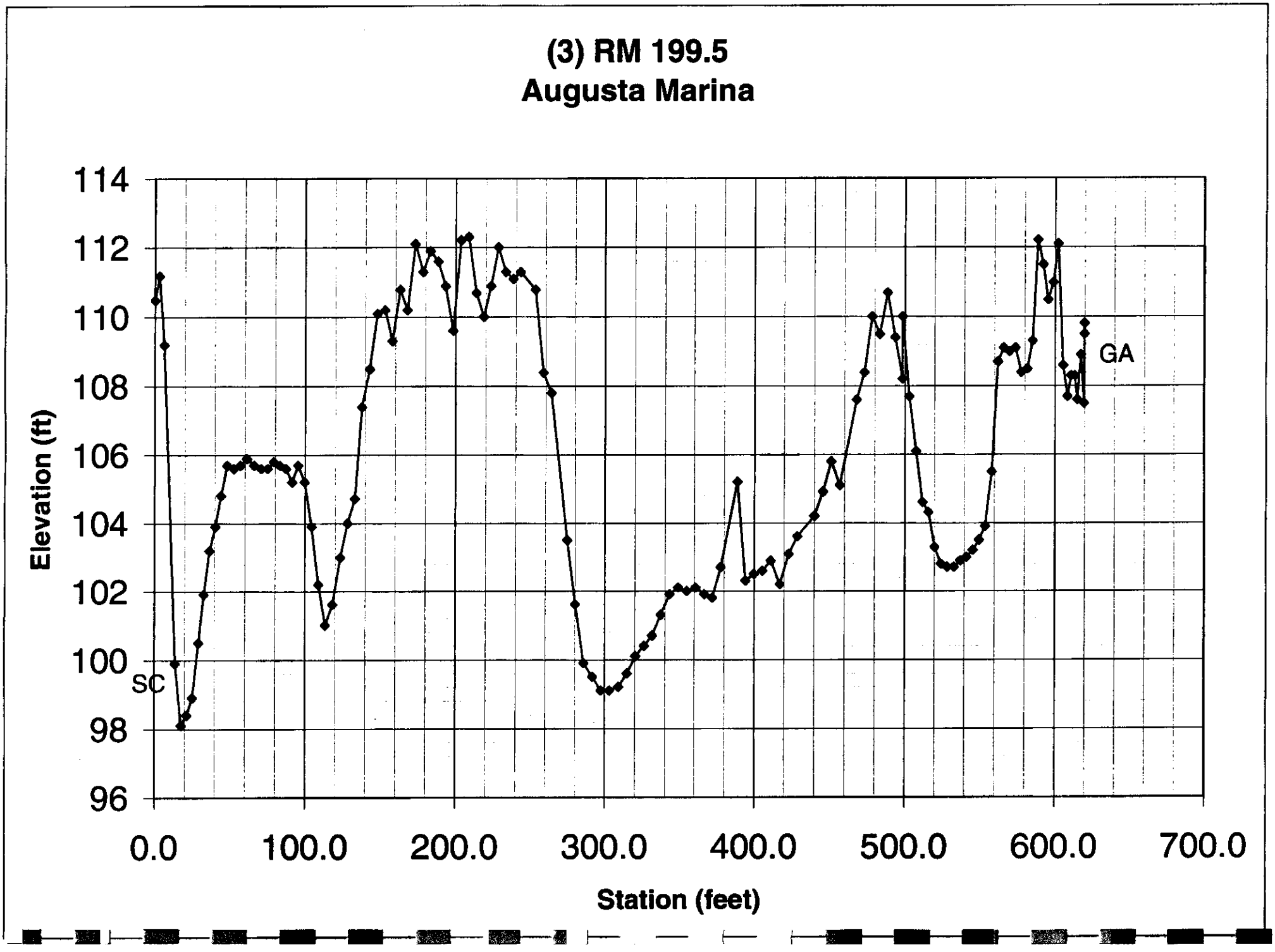
Water Surface Elevations for Low Flow Conditions With and Without the Project
and
River Bottom Elevations

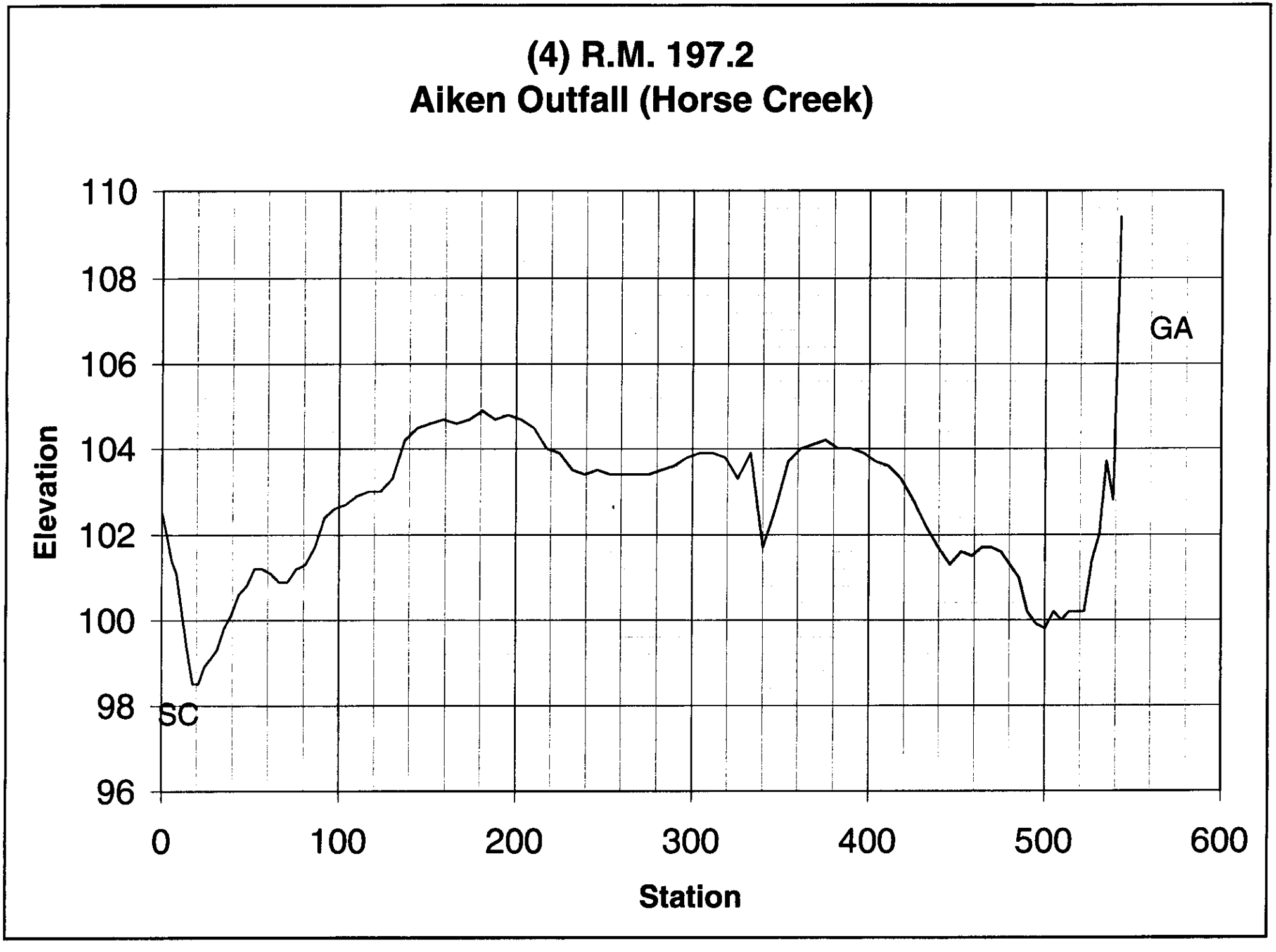
TABLE 1

River Segment	River Mile	Elevation,Existing at Low Flow (ft)	Channel Width, Existing at Low Flow (ft)	Elevation, Dam Removed, at Low Flow (ft)	Channel Width, Dam Removed, at Low Flow (ft)	Change in Water Surface (ft)	Change in Width (ft)
NSBLD	187.4	114	300	98.4	290	15.6	10
	187.55	114	480	98.5	420	15.5	60
	188.13	114	480	99.1	290	14.9	190
	188.97	114	630	101.4	340	12.6	290
	189.9	114	630	102.9	540	11.1	90
	190.77	114	560	103.7	440	10.3	120
	191.54	114	560	104.2	330	9.8	230
	192.51	114	700	104.7	340	9.3	360
PCS Nitrogen and DSM Chemicals Discharges (193.2)	193.22	114	750	105.5	530	8.5	220
Kimberly Clark Discharge (193.5)							
	194.09	114	520	106	420	8	100
General Chemical Intake (194.3)							
PCS Nitrogen and DSM Chemicals Intakes (194.4)							
	194.71	114	540	106.4	370	7.6	170
Uruquhart Discharge (195.5)	195.47	114.2	670	106.5	530	7.7	140
Kimber Clark, Uruquhart Intakes (196.0)							
	196.17	114.2	830	107.4	750	6.8	80
	197.03	114.2	630	108.1	560	6.1	70
Aiken PSA/Horse Creek Discharge (197.2)							
	197.91	114.2	690	108.9	440	5.3	250
	198.56	114.2	640	109	430	5.2	210
	199.32	114.2	670	109.1	650	5.1	20
Augusta City Marina (199.4 to 199.8)							
	199.91	114.2	700	109.1	660	5.1	40
	200.55	114.2	650	109.2	600	5	50
	201.35	114.4	590	109.3	560	5.1	30
City of North Augusta Intake (202.0)	202.08	114.4	430	109.4	400	5	30
	202.93	114.5	1030	109.6	420	4.9	610
	204.4	134	850	133.8	790	0.2	60
	205.5	135.9	850	135.8	840	0.1	10

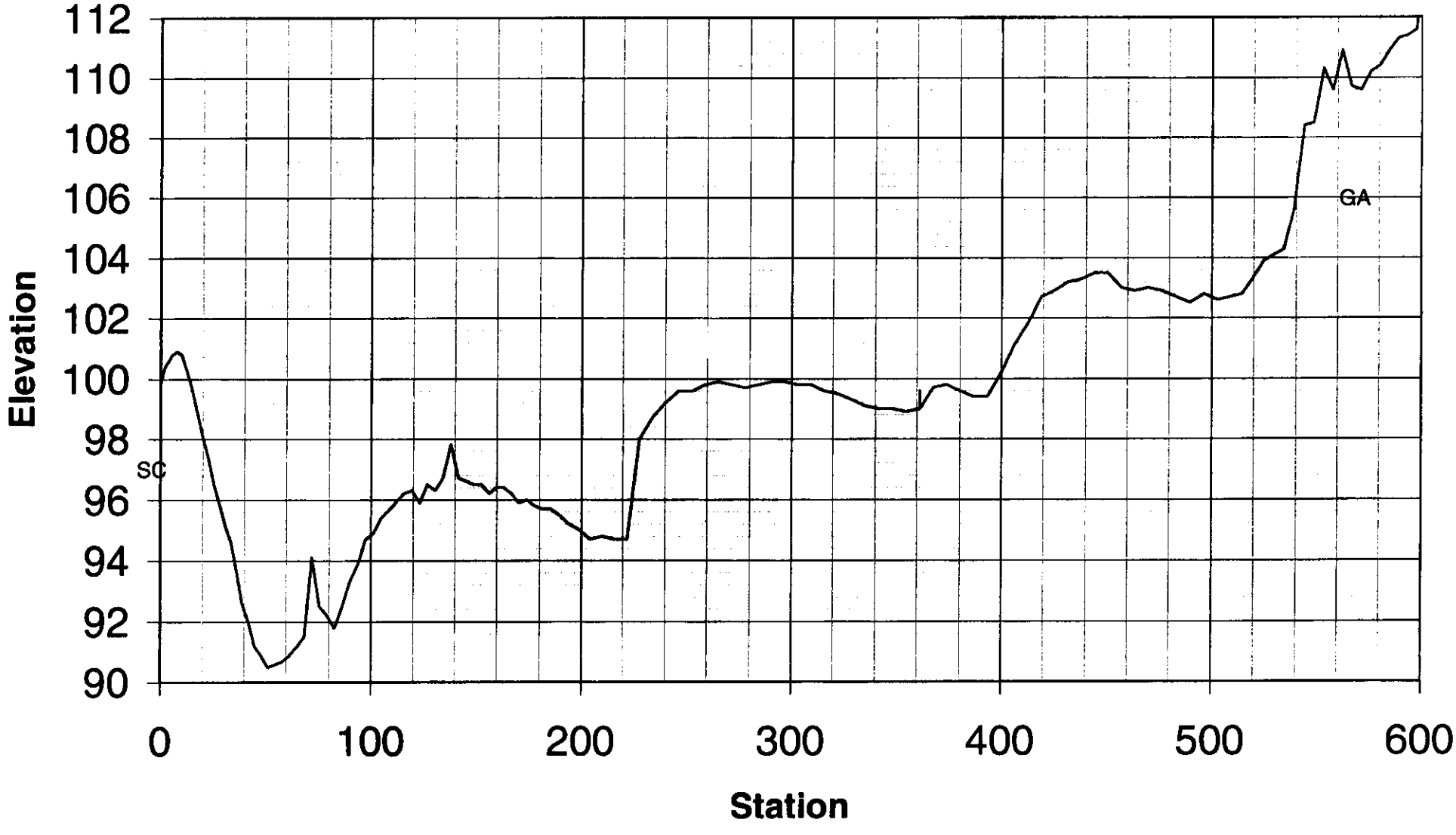

(1) RM 201.9
N. Augusta Intake
110
108
106
104
102
100
Elevation (ft NGVD)
SC
GA
0
100
200
300
400
500
Station (feet)

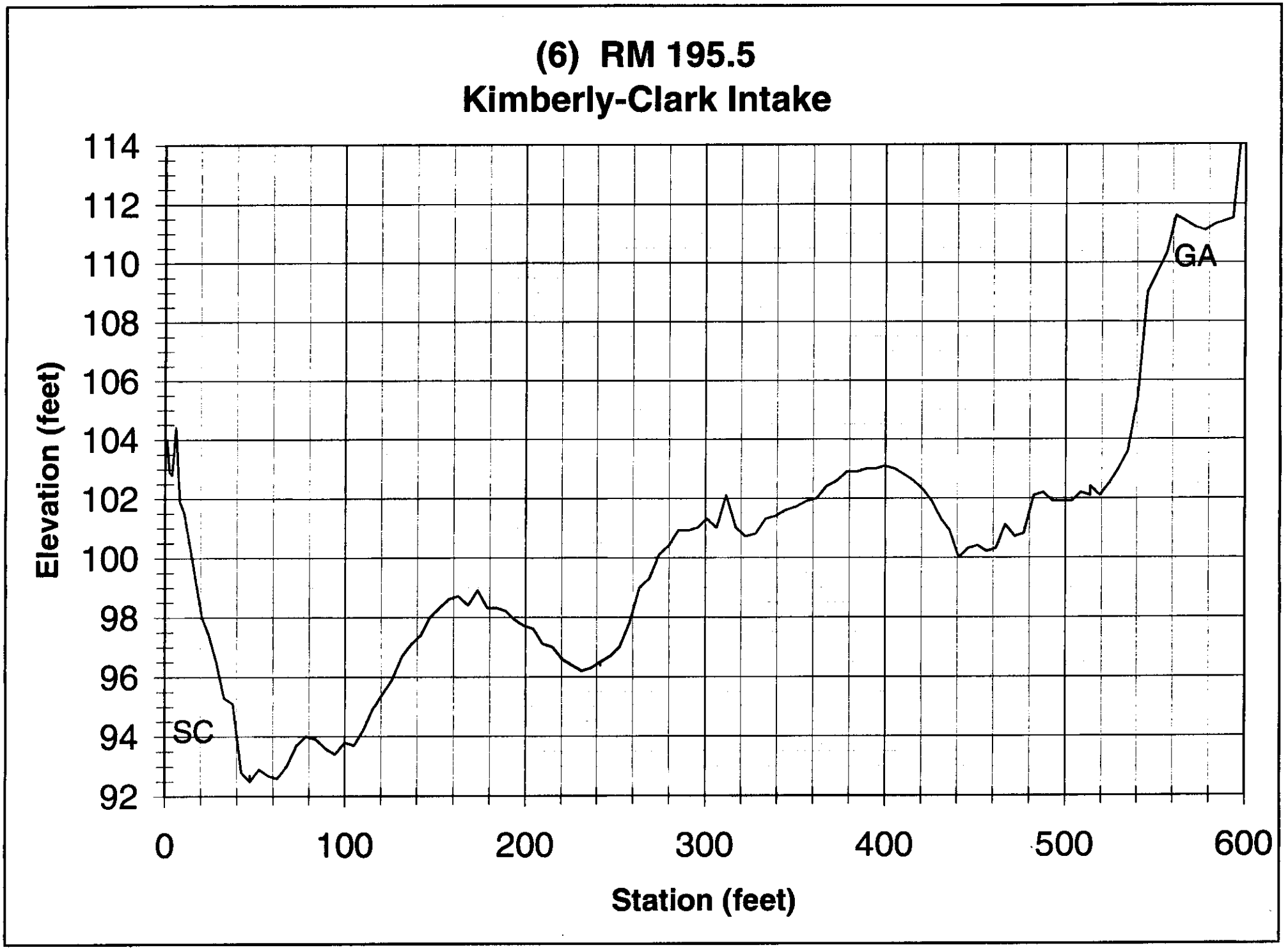

(2) RM 199.5
Augusta Marina
Elevation (ft NGVD)
116
114
112
110
108
106
104
102
100
SC
GA
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
Distance (feet)

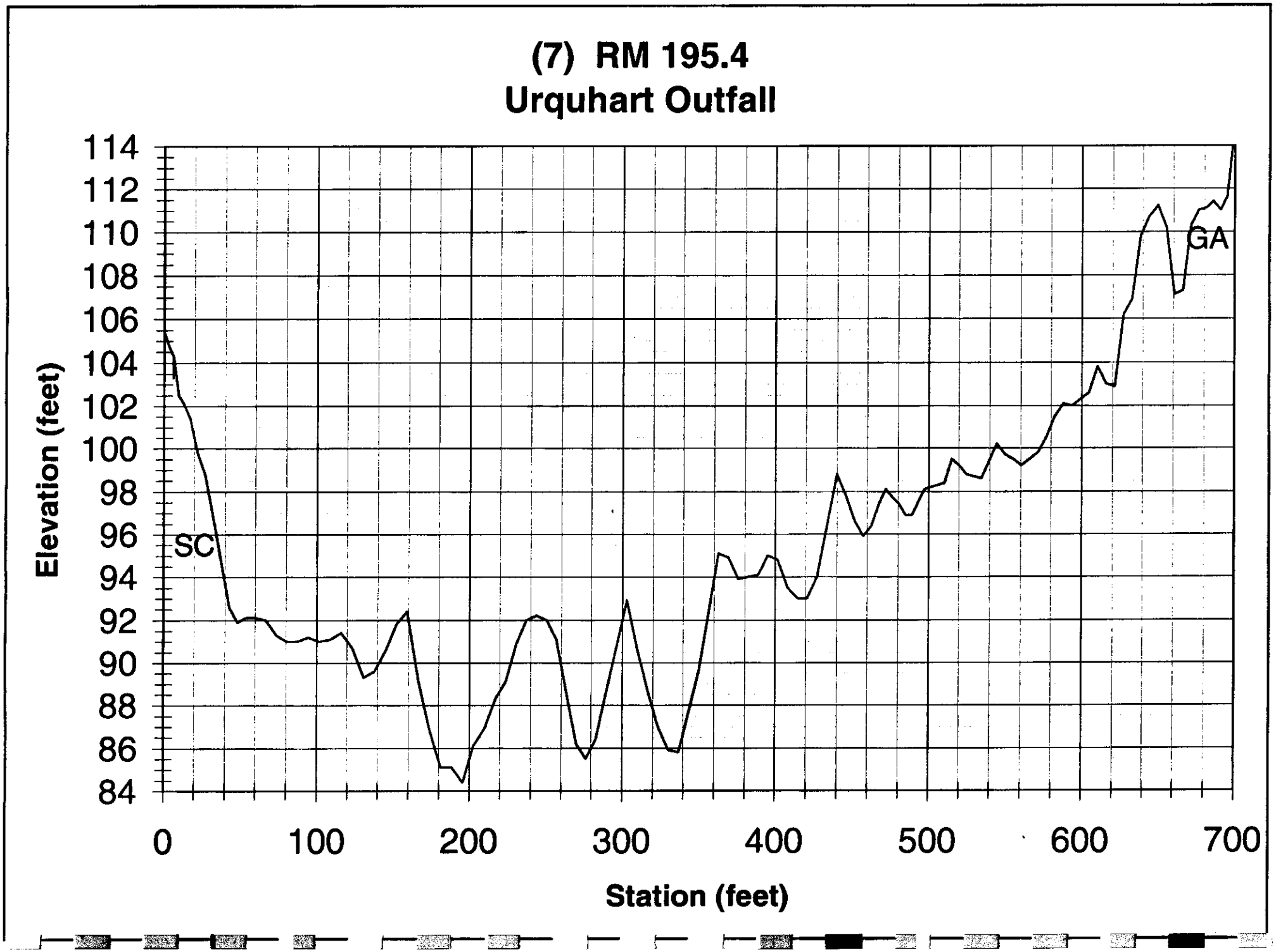

(3) RM 199.5
Augusta Marina
114
112
110
108
106
104
102
100
98
96
Elevation (ft)
SC
GA
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
Station (feet)

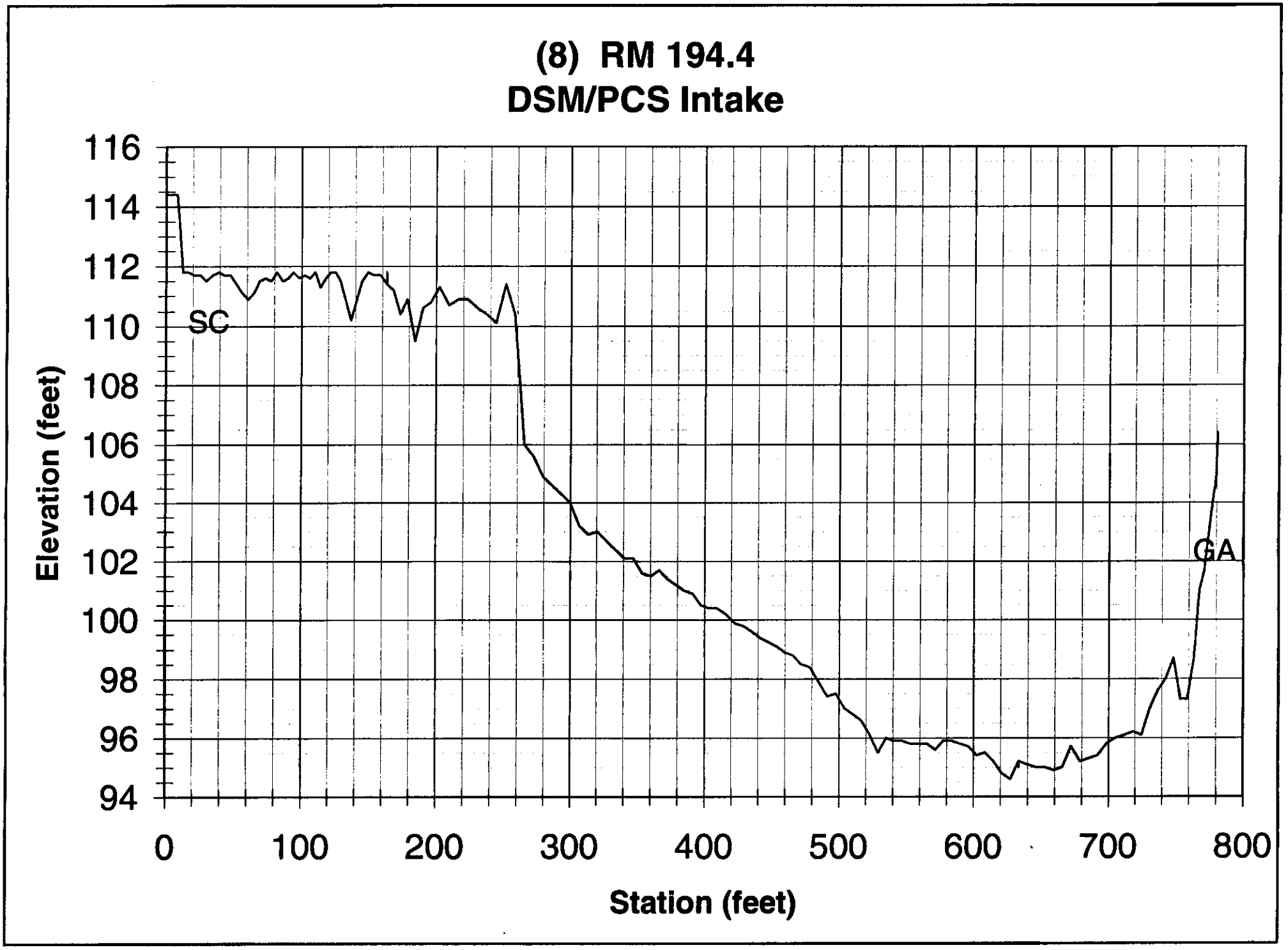

(4) R.M. 197.2
Aiken Outfall (Horse Creek)
110
108
106
104
102
100
98
96
Elevation
SC
GA
0
100
200
300
400
500
600
Station

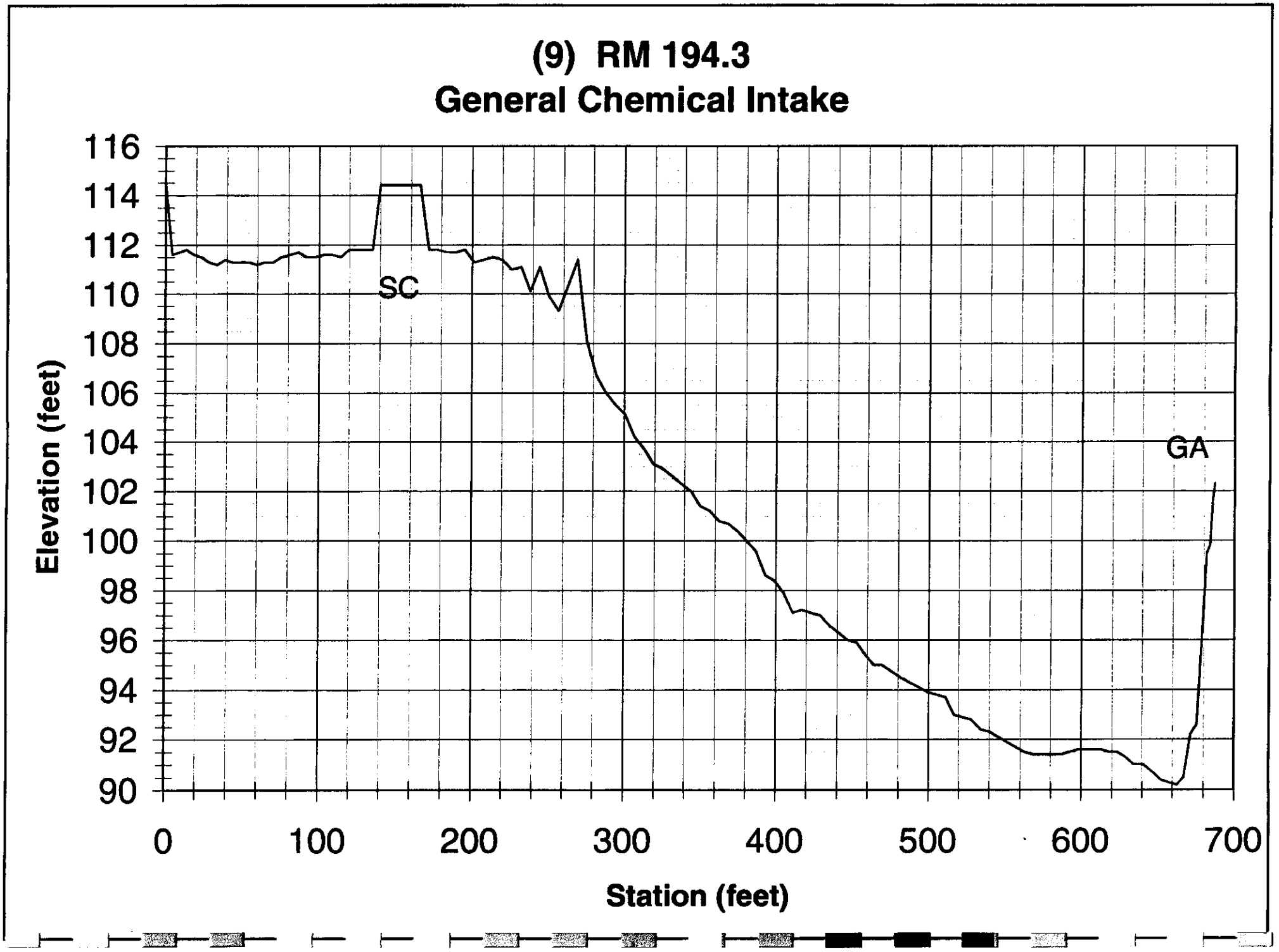
(5) RM 195.5
Urquhart Intake

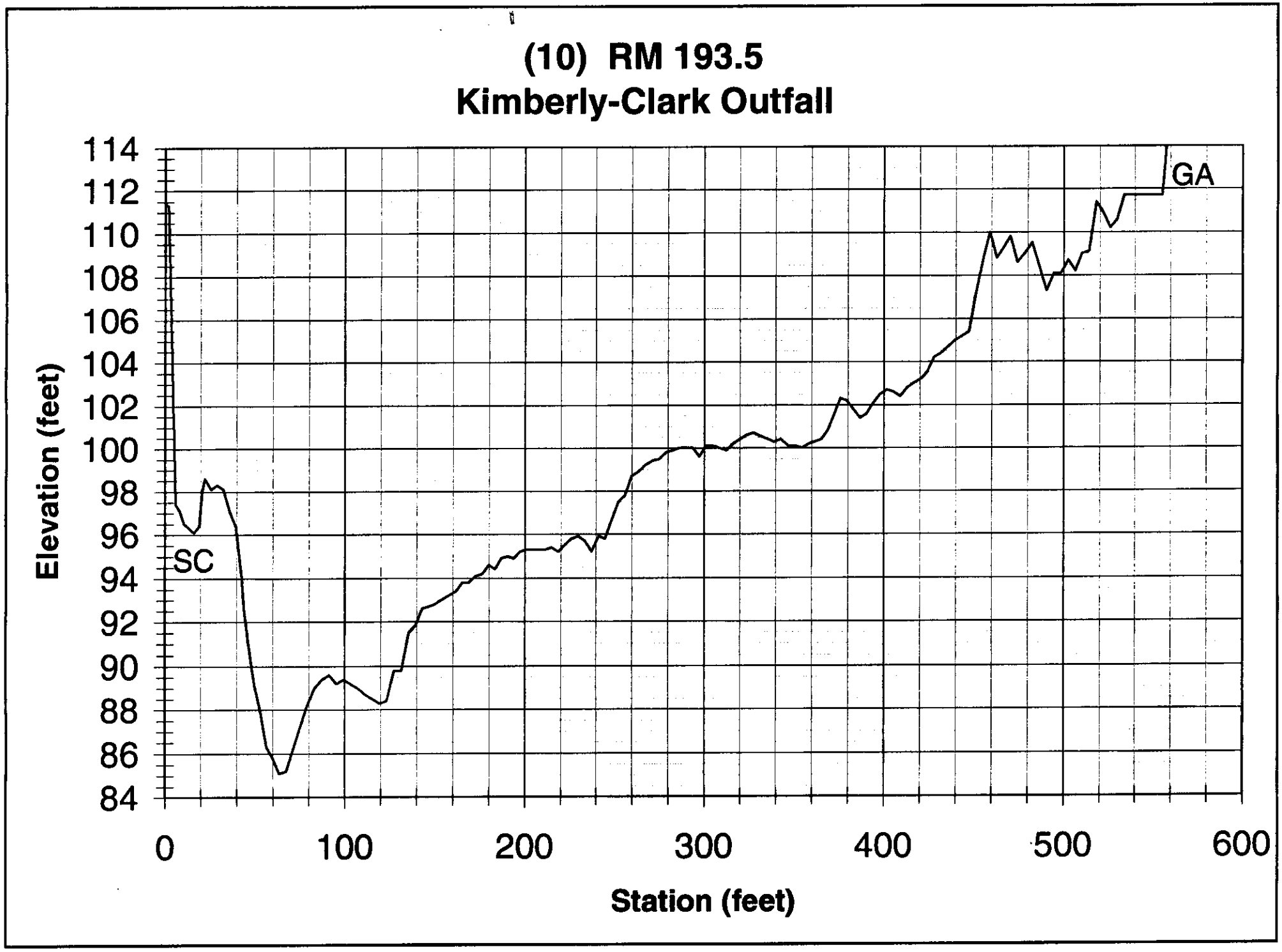


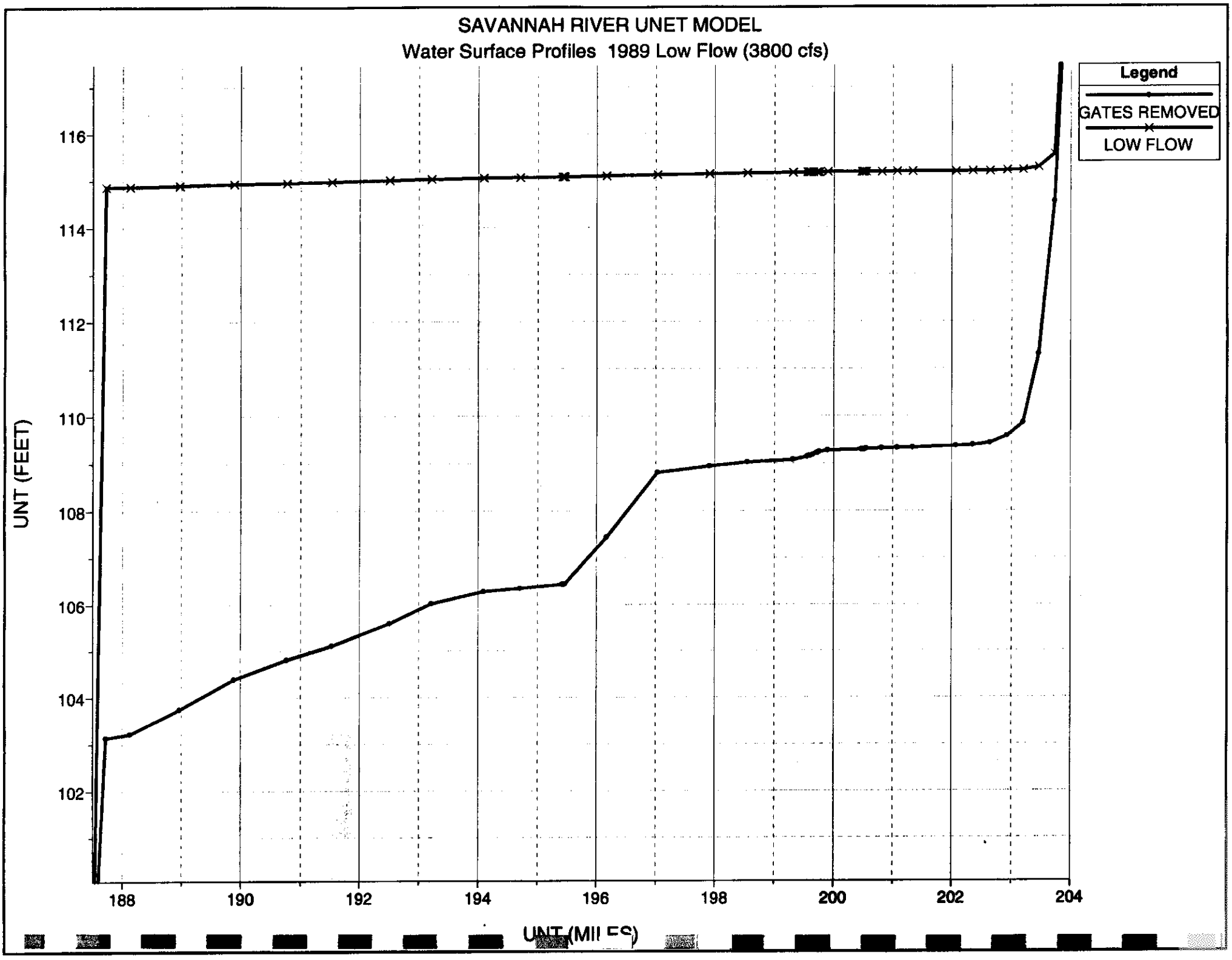

(6) RM 195.5
Kimberly-Clark Intake
Elevation (feet)
114
112
110
108
106
104
102
100
98
96
94
92
SC
GA
0
100
200
300
400
500
600
Station (feet)

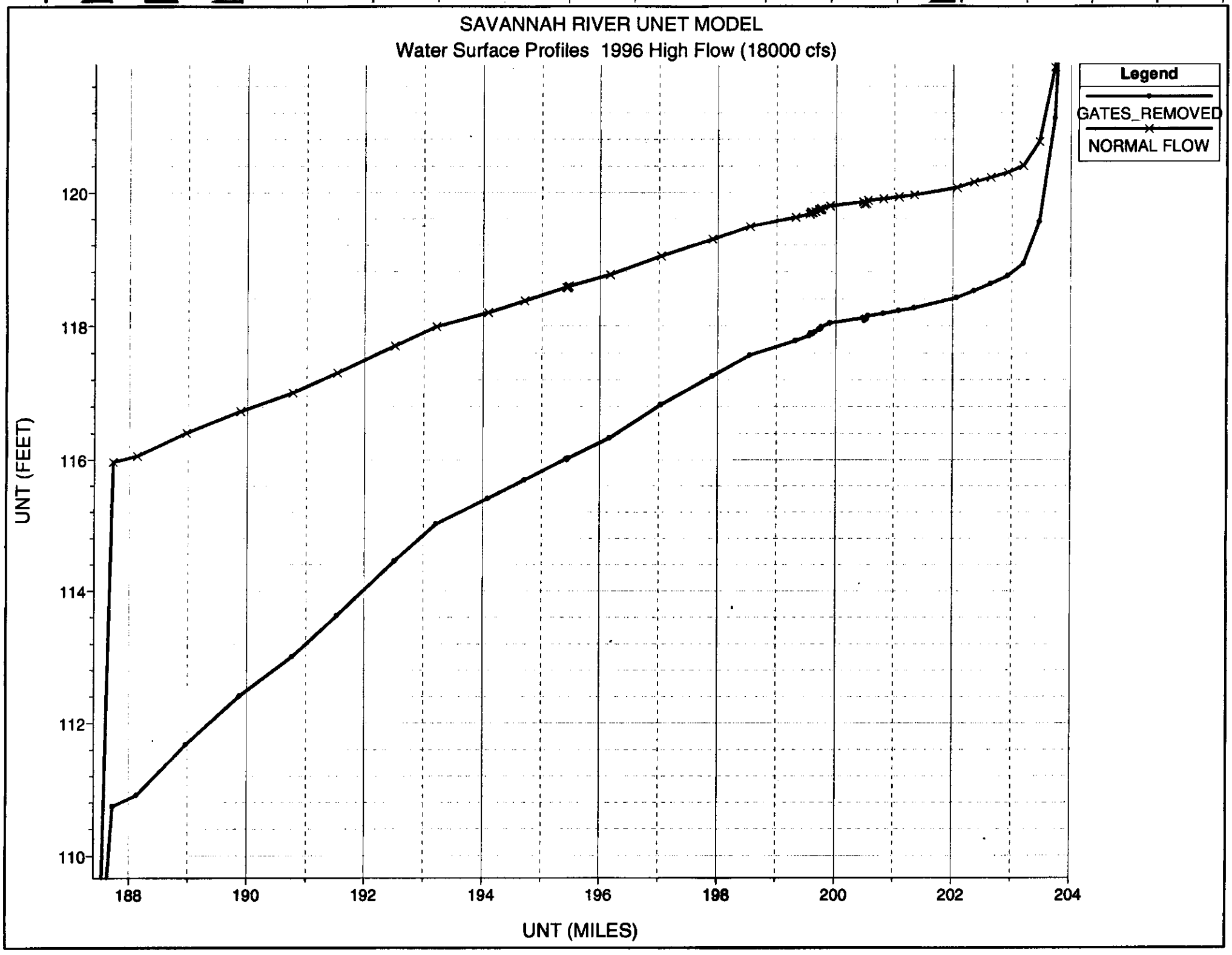

(7) RM 195.4
Urquhart Outfall
Elevation (feet)
114
112
110
108
106
104
102
100
98
96
94
92
90
88
86
84
SC
GA
0
100
200
300
400
500
600
700
Station (feet)

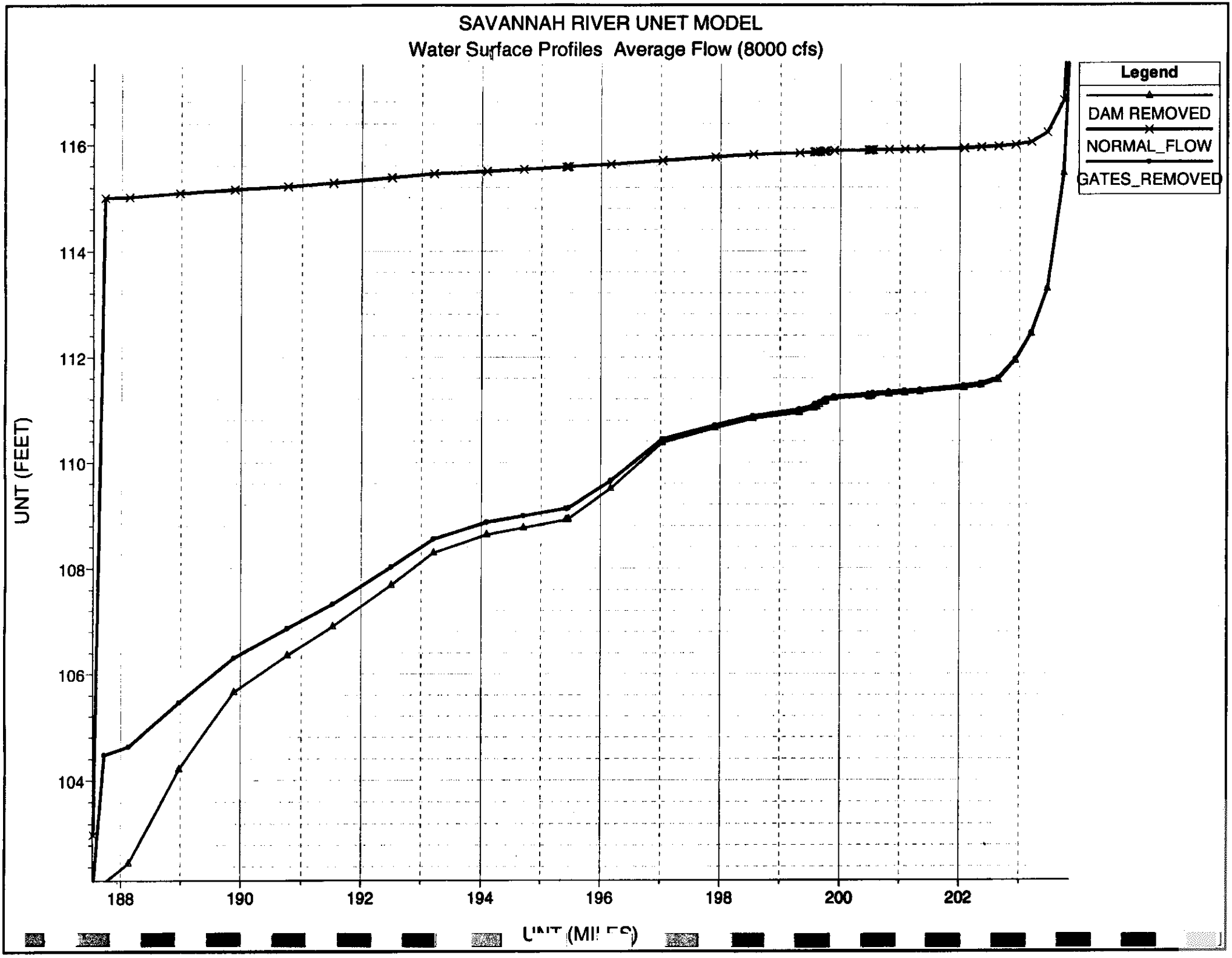

(8) RM 194.4
DSM/PCS Intake
Elevation (feet)
116
114
112
110
108
106
104
102
100
98
96
94
SC
GA
0
100
200
300
400
500
600
700
800
Station (feet)


(9) RM 194.3
General Chemical Intake
Elevation (feet)
116
114
112
110
108
106
104
102
100
98
96
94
92
90
SC
GA
0
100
200
300
400
500
600
700
Station (feet)


(10) RM 193.5
Kimberly-Clark Outfall
Elevation (feet)
114
112
110
108
106
104
102
100
98
96
94
92
90
88
86
84
SC
GA
0
100
200
300
400
500
600
Station (feet)


SAVANNAH RIVER UNET MODEL
Water Surface Profiles 1989 Low Flow (3800 cfs)
Legend
GATES REMOVED
LOW FLOW
UNT (FEET)
116
114
112
110
108
106
104
102
188
190
192
194
196
198
200
202
204
UNT (MILES)


SAVANNAH RIVER UNET MODEL
Water Surface Profiles 1996 High Flow (18000 cfs)
Legend
GATES_REMOVED
NORMAL FLOW
UNT (FEET)
120
118
116
114
112
110
188
190
192
194
196
198
200
202
204
UNT (MILES)


SAVANNAH RIVER UNET MODEL
Water Surface Profiles Average Flow (8000 cfs)
Legend
DAM REMOVED
NORMAL_FLOW
GATES_REMOVED
UNT (FEET)
116
114
112
110
108
106
104
188
190
192
194
196
198
200
202
UNT (MILES)